REMARKS

This is in response to the Office Action dated May 14, 2010. The response due date has been extended from August 14, 2010, to September 14, 2010, by payment of appropriate government fees for a one month extension of time. Claims 1-17 are pending in the application. Claims 12-17 are withdrawn from consideration and claim 7 is cancelled without prejudice or disclaimer. Claims 1 and 2 are amended herewith. No new matter is added with this amendment. Thus, with the entry of this amendment, claims 1-6 and 8-11 will be active for consideration.

I. Claim Objections

Claim 2 is objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim. In response, Applicants have amended claim 2, pursuant to the Examiner's suggestion.

II. Claim Rejections – 35 U.S.C. 112

Claims 1-11 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. According to the Examiner, Applicants' disclosure only shows clear possession of the method as it relates specifically to cellulose in a natural fiber form. Applicants respectfully traverse this rejection and further argue that the concept discovered by applicants, namely the plastic deformation of polymers by reversibly destroying the intermolecular hydrogen bridge bonds in polymer molecules, deforming the molecules and solidifying the polymer molecules again by reestablishing the hydrogen bridge bonds is applicable for all polymers having strong intermolecular bonds. Cellulose is just one example of such a polymer. In further response, applicants herewith amend claim 1 to recite a polymer that can form intermolecular hydrogen bridge bonds. Support for this amendment can be found in claim 7, which is hereby canceled in favor of the amendment to claim 1. In view of these comments and the amendment, applicants respectfully request the Examiner to withdraw this rejection.

Claims 1-11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter. The Examiner alleges that claim 1 recites the limitation "electromagnetic radiation having a defined wavelength" in both lines 2-3 and line 7. It is unclear to the Examiner whether each instance of "a defined wavelength" is intended to be the same wavelength or if the two wavelengths are intended to be different wavelengths. In response, applicants have amended claim 1 to recite "one" defined wavelength. Applicants further explain that applicants always intended claim 1 to pertain to one defined wavelength. In view of this amendment and clarification, applicants respectfully request the Examiner to reconsider and withdraw this rejection.

III. Claim Rejections – 35 U.S.C. 102

Claims 1-2 and 6-9 are rejected under 35 U.S.C. 102(b) as being anticipated by Fuisz (US 6,129,926 – hereinafter "Fuisz"). Applicants respectfully traverse this rejection.

Fuisz teaches the application of broad, full-spectrum infrared electromagnetic radiation. Fuisz does not disclose treating a polymer with electromagnetic radiation of a certain wavelength. It is important for the process of the present invention that a specific, well-defined wavelength is used for breaking the hydrogen bridge bonds of the polymer. Using broadband infrared radiation for heating the polymer has nothing to do with the present invention. The heat introduced by such broadband infrared radiation would destroy the polymer.

In further response, applicants have amended claim 1 to clarify that one wavelength of electromagnetic radiation is first <u>selected</u> from the range of 0.8 to 100μm and then used to irradiate the polymer. Support for this amendment can be found in the specification at page 9, particularly at line 29. Fuisz does not teach the selection of a specific wavelength of irradiation. According the present invention, only with radiation at one specific wavelength is it possible to break the hydrogen bridge bonds of the polymer (in a non-thermal manner) without introducing so much heat that the polymer is

destroyed. Applicants also have amended claim 1 to recite that the bonds are reversibly broken. This is an additional distinction over what is taught by Fuisz. In view of the above amendment and explanation, applicants respectfully request the Examiner to reconsider and withdraw this rejection.

III. Claim Rejections – 35 U.S.C. 103

Claims 3-4 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fuisz as applied to Claim 1 above, in view of Tsai et al. (US 6,479,001 – hereinafter "Tsai"), and further in view of Pratt (US 4,115,280 – hereinafter "Pratt"). Specifically, the Examiner states that Tsai teaches disrupting secondary valence bonds to provide the benefit of facilitating the movement of polymer chains during shearing events and lowering the melting temperature and that Pratt teaches that it is known and predictable technique to disrupt secondary valence bonds/hydrogen bonds with a laser operating at a wavelength corresponding to the bond energy of the hydrogen bonds (Abstract).

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fuisz as applied to Claim 1 above, in view of Eckl et al. (US 6,478,494 – hereinafter "Eckl"). Eckl is cited for teaching extruding and shaping natural polymers (Abstract), although cellulose is not mentioned. According to the Examiner (Office Action, paragraph 24), one of skill in the art at the time of the invention would have found it obvious to substitute cellulose for chitin, lignin or other natural polymers discussed by Eckl, with a reasonable expectation of success, since cellulose is a prominent natural polymer, of which there are a finite number identified.

Claims 1-4 and 7-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eckl, in view of Tsai and Pratt. The Examiner relies upon Eckl for allegedly teaching a method for the plastic deformation of polymers, including the polysaccharide chitin, which is capable of forming intermolecular hydrogen bridge bonds (Column 2, lines 15-35), comprising simultaneously treating the polymers with pressure and shearing and thermal energy supplied to the polymer, wherein the method is carried out

at relatively low temperatures, wherein the Examiner considers the extrusion process to simultaneously supply pressure and shearing. The Examiner admits that Eckl is silent as to whether the additives affect secondary valence bonds of the polymers. The Examiner relies upon Pratt and Tsai for allegedly teaching a laser having a wavelength corresponding to a polymer's secondary valence bonds allows for lower melt temperatures and lower torque requirements for an extruder.

In the office action at page 11, first paragraph, the Examiner states that:

"The Examiner additionally notes that such a hypothetical combination [Eckl, Pratt and Tsai] would have a region at least near the entrance of the extruder wherein the polymer would be deformed at a temperature at which the polymer melts, since all the conditions believed to be necessary for such deformation to occur would be present."

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Eckl, Tsai and Pratt as applied to Claim 1 above, and further in view of Craggs et al. (US 5,095,654 – hereinafter "Craggs"). Craggs is cited for teaching that solid phase deformation of [sic] comprises applying pressure of 52.5 N/mm^2 for the benefit of providing enough pressure to ensure a constant haul off speed (Abstract and Column 6, lines 7-33).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Eckl, Tsai, and Pratt as applied to Claim 1 above, and further in view of Fuisz. The Examiner explains that the previous combination teaches the general method, but is silent on specific shear rates acting on the polymer. Fuisz is cited for generally teaching that sufficient shearing applied to a polymer results in a "transformation of physical and/or chemical structure without degradation of the material" and that an appropriate shear rate to achieve this effect is in the range from 10^0 to 10^6 s^{-1}, namely 3600-3800 rpm for the above quoted benefit of transformation without degradation (Abstract and Column 3, lines 5-15).

Applicants respectfully traverse these rejections. Applicants have addressed Fuisz above. Tsai and Pratt teach similar processes, the combination of which does not cure the deficiencies in Fuisz.

In fact, both Tsai and Pratt teach away from the subject matter of the rejected claims. Pratt (Abstract) discloses an apparatus for altering (*i.e.* deactivating or activating) the biological or chemical activity of macromolecular species. The apparatus employs laser beam radiation at a frequency that excites vibrational and rotational states of the irradiated species and at an intensity sufficient to activate the species (but below the denaturation level) or to a level such that the weak bonds, *e.g.*, hydrogen bonds, that determine the special character and enhances the biological activity of macromolecules, are irreversibly broken to such an extent that the macromolecule loses its original form (the process of denaturation) and assumes an inactive (denatured) configuration. In the case of absorbing materials, pulses of energy from the beam, which are obtained by interrupting a c.w. beam, using a pulsed laser or as a Q-switched configuration, are used.

As such, Pratt describes an invention that is primarily directed to the breakdown of large molecules. Arguably, Pratt is not in the same art as the present invention. In any event, Pratt teaches the destruction of macromolecules and microorganisms by irreversibly breaking hydrogen bridge bonds. In contrast, the present invention is a method which works only because the hydrogen bonds are not irreversibly destroyed and the polymer molecules are not broken down. In the present application, at page 89, first paragraph, applicants state that "[t]he energy introduced into the system via the electromagnetic radiation then results in the hydrogen bridge bonds being broken. As a result of the shearing acting on the polymer, the polymer is then plastically deformed. If the energy input is stopped and the plastic deformation ceases, the molecules form new hydrogen bridge bonds." (emphasis added) Also, at page 12, lines 18-21, applicants explain that "[t]he plastic deformation is thus a shear deformation..." and that "[w]hen the plastic deformation ceases, the molecules form new secondary valency bonds, e.g., hydrogen bridge bonds." (emphasis added) Thus, the process of the

present invention is based on the idea that hydrogen bridge bonds are reversibly broken. The hydrogen bridge bonds are broken, and the polymer is deformed by shear forces. Then, the hydrogen bridge bonds form again, resulting in a molten polymer. The process of breaking the hydrogen bridge bonds in the present invention is thus reversible. This is in clear contrast and directly against the explicit teaching of Pratt, which destroys proteins by irreversibly breaking the hydrogen bridge bonds. Thus, instead of teaching the present invention or guiding the skilled artisan toward the present invention, Pratt teaches to irreversibly destroy proteins or microorganisms by laser radiation.

In further response, applicants have amended claim 1 to recite that the wavelength of the electromagnetic radiation reversibly breaks said bonds.

Tsai similarly teaches the irreversible destruction of intermolecular bonds by using a compatibilizer. According to Tsai, compatibilizers function as a plasticizer to improve the processing of the thermoplastic composition and then serve as a surfactant in a processed fiber or nonwoven structure by modifying the contact angle of the processed material. According to Tsai, the compatibilizer replaces the secondary valence bonds holding together the various polymer chains with compatibilizer to polymer valance bonds, thus facilitating the movement of the polymer chain segments (column 12, lines 4 to 8).

The process taught by Tsai is thus an irreversible process. The compatibilizer "replaces" the hydrogen bridge bonds between the polymers and the hydrogen bridge bonds cannot be formed again. This is in direct contrast to the present invention, where hydrogen bridge bonds are broken by electromagnetic radiation, the polymer is deformed by shear force and then, after the deformation, the hydrogen bridge bonds form again.

The process of Tsai necessarily weakens the polymer and the process of Pratt completely destroys the macromolecules. This is true because the hydrogen bridge bonds between the polymer molecules are irreversibly destroyed. In contrast, in the

process of the present invention, the polymer structure is not weakened because although the hydrogen bridge bonds between the polymer molecules are broken and the molecules are deformed, the hydrogen bridge bonds form again. This process only leads to the plastic deformation and thus to a molten polymer. Applicants again direct the Examiner's attention to the amendment to claim 1 to recite that the wavelength of the electromagnetic radiation reversibly breaks said bonds.

With regard to the Examiner's rejections over Eckl in combination with Fuisz or in combination with Tsai and Pratt, applicants point out that Eckl is concerned with a molting process for polymers using heat. Eckl teaches using natural oils to reduce the melting and extrusion temperatures. Applicants argue that one of skill in the art would not arrive at the inventions of any of the rejected claims through a combination of Eckl with the other cited prior art. Secondary references, like Craggs, do not cure this.

With regard to the Examiner's comments at page 11, first paragraph, the Examiner apparently considers that the plastic deformation of the polymer according to the present invention could occur near the entrance of the extruder. This, however, is not possible in the process of the present invention. According to the present invention, the polymer melts only where it is irradiated by electromagnetic radiation of one specific wavelength. If the polymer would be irradiated at the entrance of the extruder, the polymer would melt at the entrance of the extruder but immediately thereafter the polymer would solidify again and jam the extruder. Therefore, if the process in the present invention is carried out in an extruder, melting of the polymer by irradiation with one specific wavelength must occur near the nozzle of the extruder so that only at the nozzle the polymer melts and then solidifies immediately after leaving the extruder

Applicants have shown the deficiencies in the individual references cited by the Examiner. Applicants respectfully assert that in view of these deficiencies, one could not arrive at the claimed invention, as amended, through the various combinations of references proposed by the Examiner. As such, the rejections under 35 USC § 103 are insupportable and should be withdrawn.

CONCLUSION

In light of the above amendments, applicants respectfully request that all rejections and objections be withdrawn and that pending claims be allowed.

Should the Examiner believe that anything further is necessary in order to place this application in better condition for allowance, the Examiner is requested to contact the undersigned at the telephone number listed below.

In the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. § 1.136(a), and any fees required therefore are hereby authorized to be charged to our Deposit Account No. 01-2300 referencing docket number 029368-00035.

Respectfully submitted,

Patricia D. Granados

Patricia D. Granados
Attorney for Applicants
Reg. No.: 33,683

Date: September 8, 2010
Customer No. 04372
Arent Fox LLP
1050 Connecticut Avenue, NW
Washington, D.C. 20036-5339
Telephone: (202) 775-5755
Facsimile: (202) 638-4810

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